

Reed Bed Systems and Treatment Wetlands

**Summary overview of
domestic scale
constructed wetlands and reed beds
for effluent treatment**

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2022

Treatment Wetlands

Treatment wetlands can be subdivided into the following primary categories; may include ponds as part of the overall layout, and can be hybrids or combinations of the list below:

- ⤴ Soil-based constructed wetlands (Free Water Surface systems - FWS)
- ⤴ Horizontal Sub Surface Flow gravel reed beds (HSSF)
- ⤴ Vertical-flow reed beds (VF)

Other treatment wetland types include Integrated Constructed Wetlands (ICWs), sand-filled vertical flow reed beds and modular packaged reed beds. These are outlined in *Septic Tank Options and Alternatives*, (Harty F. (2014) Permanent Publications, Hampshire, UK) but are not detailed further below.

Standard treatment wetlands follow a settlement tank or treatment system; and the treated effluent is routed to an infiltration area for disposal to ground, as follows:



Pros and Cons compared to other treatment options

Pros

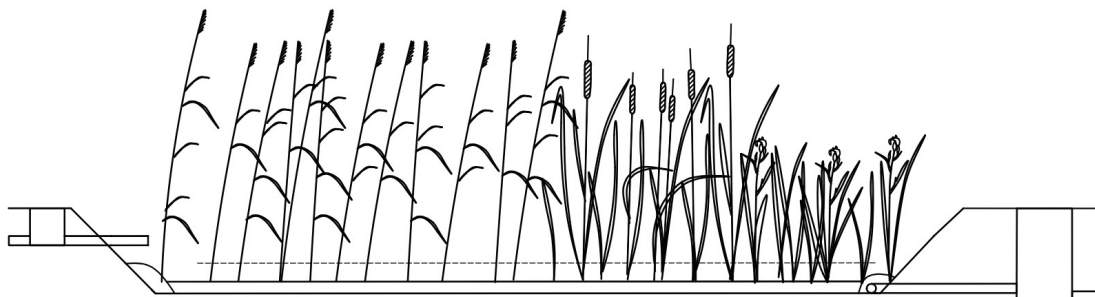
- ⤴ Low construction and running costs.
- ⤴ Zero electricity inputs where pumping of effluent is not needed.
- ⤴ Robust systems, tolerant to variable or seasonal loading rates.
- ⤴ Can achieve excellent reductions of biochemical oxygen demand (BOD) and suspended solids (SS).
- ⤴ Can remove a wide range of pollutants.
- ⤴ Secondary benefits in terms of potential wildlife habitat enhancement and visual aesthetics.
- ⤴ Versatile systems for use with old or overloaded systems.

Cons:

- ⤴ Need lots of space.
- ⤴ Require fencing.
- ⤴ Biodiversity benefits may include unwanted insects.
- ⤴ Possible odour nuisance, depending on detergent use and proximity.
- ⤴ Can become saturated with sediment or phosphorus over time.

Soil-based constructed wetlands

These are marsh type systems, typically lined with indigenous impermeable clay subsoil or a plastic membrane. Surface area requirements 20m²/person for secondary treatment; plus 10m²/person for tertiary treatment where needed.

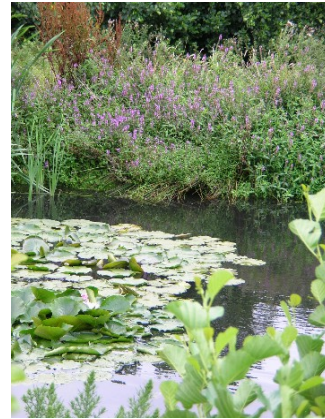


Pros and Cons compared to other treatment wetlands

Pros

- ⤴ Offer higher treatment than gravel options based on Irish EPA design sizing.

- ⤴ Resilient to sludge overloading and hydraulic shock loading (i.e. sudden overloads of effluent).
 - ⤴ Can receive stormwater from roof surfaces as well as grey and black water and still provide reliable treatment standards.
 - ⤴ Potentially the lowest cost systems: where subsoil conditions negate plastic lining.
 - ⤴ Can be the lowest embedded energy treatment option (excluding dry toilets which don't even need the septic tank; and willow systems which actively sequester carbon).
 - ⤴ Best treatment wetlands for wildlife.
- Cons**
- ⤴ Greater potential for odour generation.
 - ⤴ Possible safety hazard with (shallow) open water.
 - ⤴ Unsuitable for small sites.
 - ⤴ Larger than gravel systems.
 - ⤴ EPA Code requires 2m metal perimeter fence.



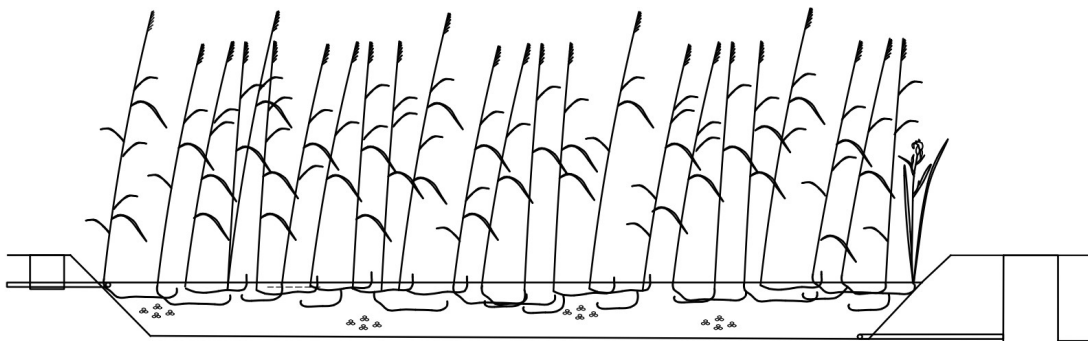
Ponds can be a beautiful addition to treatment wetlands, but are not generally used in domestic designs on account of deep open water.



Newly planted wetland system for single dwelling, filled with clean water for planting and plant establishment.

Horizontal-flow gravel reed beds

These are gravel filled basins planted with a selection of wetland plants which provide aeration and filtration to the effluent passing beneath the surface of the gravel. EPA Code of Practice recommends a size of 5m²/pe for secondary treatment and 1m²/pe for tertiary treatment, but a slightly larger sizing (allow 8m² and 2m² respectively) will achieve greater treatment.



Pros and Cons for HSSF reed beds compared to other treatment wetlands

Pros

- ⤴ Generally smaller than soil based constructed wetland systems.
- ⤴ No open water as safety hazard; and odour generation may be reduced.
- ⤴ Lower head loss: more suitable for sites with minimal gradients.

Cons

- ⤴ More expensive than clay lined wetlands.
- ⤴ Septic tank maintenance vital. Less resilient to sludge loadings.
- ⤴ Requires occasional replacement of substrate and plants (may be 10-20 years).
- ⤴ May have exposed effluent at inlet section, varies with design and maintenance.



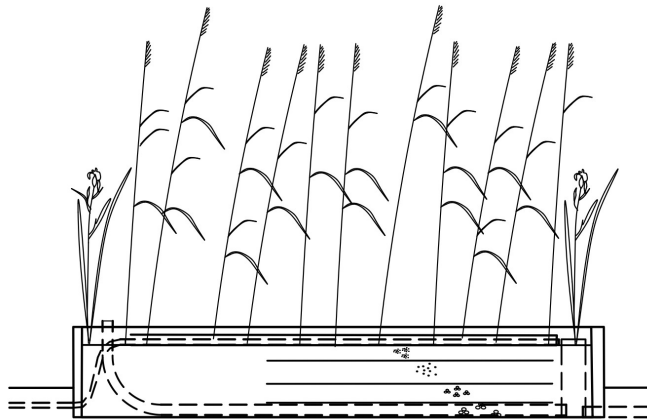
Newly planted reed bed system



The same reed bed a year and a half later

Vertical-flow gravel reed beds

Pump fed (with exceptions) stone media filter planted with common reed and yellow flag Iris. EPA size requirements are for 4m²/pe for secondary treatment and 2m²/pe for tertiary treatment. Do not use sand on top layer due to potential for system clogging.

**Pros and Cons compared to other treatment wetlands****Pros**

- ⤴ Can achieve greater oxygenation/treatment of effluent in a smaller surface area.
- ⤴ Good ammonia reduction potential.
- ⤴ Effective component in overall treatment wetland design.

Cons

- ⤴ Typically pumped (but gravity dosing boxes may be used where gradient allows).
- ⤴ Typically used with a horizontal flow reed bed, so additional cost and space rather than replacement of same.
- ⤴ Good septic tank maintenance and/or pretreatment needed.

Treatment wetlands comparison summary

Treatment Wetlands Compared (also showing standard proprietary system for comparison)

	CW	HF-RBTS	VF-RBTS	STW
Treatment effectiveness	High	Medium	Medium	Medium
Ecological footprint	Low	Med	Med	High
Wildlife value	High	Medium	Medium	Low
Capital cost on standard site	€€	€€	€€	€€
Capital cost on heavy soils	€	€€	€€	€€
Running costs	€	€	€€	€€€
Odour potential	High	Low	Medium	Low
Safety risk	High	Low	Medium	Low
Size	Large	Medium	Medium	Small
Fencing	2m metal	Child-proof	Child-proof	No
Electricity needed	No	No	Yes, for pump	Yes, 24/7
Resilience to sludge overloading	High	Low	Low	Medium
Can receive stormwater inputs	Yes	No	No	No

CW – soil based constructed wetland

HF-RBTS – Horizontal flow reed bed treatment system

VF-RBTS – Vertical flow reed bed treatment system

STW – standard packaged mechanical aerated sewage treatment system

Note that these are general details only. All of the above can have exceptions to every entry outlined, but in general terms the details are accurate.

The information presented in this document is complimentary to *Septic Tank Options and Alternatives* and *Permaculture Guide to Reed Beds*, available at <https://www.wetlandsystems.ie/Bookshop.html>

